

Radiological Emergencies; Tools, Training, & National Assistance for First Responders

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<http://www-cms.llnl.gov/seaborginstitute/training.html> *Science in the National Interest*



Lawrence Livermore National Laboratory

Department of Energy
University of California

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Objectives



- **Examples of Radiological Emergencies**
- **Defining “First Responders”**
- **Radiological Assessment Tools**
- **Training**
- **Assistance Resources**

Types of Radiological Emergency Responses



- Nuclear Facility Release
- Transportation Accident



- Dispersed Radioactive Material
- Lost or Fugitive sources

First Responders



- **Fire Fighters / Paramedics** (Responding to fires, explosions, hazmat spills, and medical calls)



- **Law Enforcement** (investigating suspicious activity, serving warrants, etc..)
- **US Coast Guard** (inspecting vessels, responding to waterborne emergencies)



- **Hospital Emergency Department Staff** (large event and walk in emergencies)

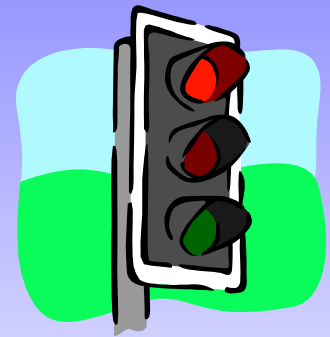
Recognition of a Radiological Event



- The radiological nature of **nuclear facility** and **placarded transportation accidents** may be self evident, however
- Less obvious is the radiological component of;
 - Fire involving radioactive materials,
 - Radiological “dirty bomb,”
 - Dispersed material (fire, sprayed, etc..), and
 - Exposed high intensity sources.
- Tools are needed to help first responders recognize the radiological nature of an event.

Desirable Properties for Detection Tools for First Responders

- Alerts user of radiation above background
- Detect alpha & beta radiation
- Records dose
- Alarms in hazardous situations
- Work continuously without user intervention
- Simple and intuitive, requiring little training
- Small size, something easily worn
- Inexpensive to purchase and maintain



Tools: *Electronic Dosimeters*

The Pros

- Alarms in hazardous situations.
- Can identify a significant radiological event.
- Records dose.
- Long battery life.
- Small Size.
- Simple operation and often very rugged



The Cons

- Not necessarily sensitive enough to detect low levels of radiation.
- Won't detect alpha or low energy beta radiation



Tools: *Electronic Dosimeters*

Description:

About the size of a pager, these electronic devices track the total radiation dose received by the wearer. They often use low power silicon chips or small Geiger-Müller (GM) tubes to measure dose. Most have the ability to alarm at certain dose rates or total dose. Although these devices are not sensitive enough to necessarily find fugitive radioactive material, they can quickly detect significant events and **protect the wearer from overexposure**.

Application:

Well suited for emergency responders who may need to quickly enter a scene, these devices can help ensure responder safety by alerting them to potentially hazardous radiation levels without any user activation or operation. The units can also alert the wearer when unusual radiation levels are present, though they may not be sensitive enough to find low levels, i.e., $< 5 \mu\text{Sv/hr}$ ($< 0.5 \text{ mrem/hr}$).

Examples:

Canberra Industries: [http://ww2.canberra.com/PCatalog.nsf/all/RPI_PDF/\\$file/ANUDR13.pdf](http://ww2.canberra.com/PCatalog.nsf/all/RPI_PDF/$file/ANUDR13.pdf),
[http://ww2.canberra.com/PCatalog.nsf/all/RPI_PDF/\\$file/Dosicard.pdf](http://ww2.canberra.com/PCatalog.nsf/all/RPI_PDF/$file/Dosicard.pdf)

Far West Technology, Inc: http://www.fwt.com/hpi/hpi_4083ds.htm

MGP Instruments: http://www.mgpi.com/html/en/produits/masque.cfm?le_num_prod=87

POLIMASTER, Ltd.: <http://www.polimaster.com/en/products/dosimeters.htm>

Science Applications International Corporation (SAIC): <http://www.saic.com/products/security/pd3i/pd3i.html>

Siemens Environmental Systems - UK: http://www.siemens.co.uk/env-sys/uk/electronic_dosimetry/epd.shtml

Thermo Electron Corp: <http://www.thermomp.co.uk/rmp/index.html>



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represent an
endorsement**



Tools: *Personal Radiation Proximity Alert Systems*

Pros

- Very sensitive. Alerts the user of any statistically significant changes to the natural background radiation levels.
- Useful for finding contraband radioactive material.
- Good battery life
- Small Size
- Simple operation



Cons

- Will alarm in the presence of legitimate commercial, medical, or naturally occurring sources of radiation.
- Does not accurately measure (or work in) high dose rates which would be of concern to emergency responders performing rescue operations.
- Won't detect alpha or low energy beta contamination (other than by any associated dose field)
- Expensive (\$800 – \$2,000)



Tools: *Personal Radiation Proximity Alert Systems*

Examples: Description: Application:

Often called “Radiation Pagers,” and similar in appearance to the electronic dosimeters, these units have the very different function of finding low levels of radiation using very sensitive crystal or plastic scintillators. Although good for finding contraband radioactive material, these units do not have the range necessary for personnel protection (i.e., high dose rates).

Well suited for law enforcement or inspectors, these devices can alert the wearer to any unusual radiation in their proximity. These devices are best used when there is an opportunity for a measured response, as most alerts will occur from legitimate commercial, medical, or natural radioactive material. Training and protocols need to be provided to properly resolve any alarms.

POLIMASTER, Ltd: <http://www.polimaster.com/en/products/ratemeters.htm>

Sensor Technology Engineering, Inc <http://www.nttc.edu/ertProgram/radpagers.asp>

T_A TECHNICAL ASSOCIATES: <http://www.tech-associates.com/dept/sales/product-info/dsi-2.html>

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B.R. Buddemeier



Tools: Isotope Identification Equipment (Gamma Spectroscopy)

Pros

- Very sensitive. Alerts the user of any statistically significant changes to the natural background radiation levels.
- Useful for finding contraband radioactive material.
- Often tracks dose rates and total dose of user while on.
- Can identify many common isotopes

Cons

- Although fairly good at identifying common isotopes with simple spectra, these units can not identify all possible isotopes of concern and can also mis-identify isotopes.
- Will alarm in the presence of legitimate commercial, medical, or naturally occurring sources of radiation (though the analysis capability can often help resolve this)
- Expensive (\$8,000 - \$12,000)
- Won't detect alpha or low energy beta contamination.
- Requires extensive training or support to use properly



Tools: Isotope Identification Equipment (Gamma Spectroscopy)

Description:

These expensive and sophisticated units use the different gamma ray “signatures” given off by the radioactive material to identify the originating isotope(s). Proper identification of the isotope is important for determining the appropriate response actions. Although the analysis being performed is complicated, these units offer a simple interface to help non technical users make a measurement. Many of the units have modes of operations similar to the proximity alert and electronic dosimeters.

Application:

Best suited for experienced users or well trained and practiced responders, these units will help identify the radioactive material involved at a scene or in contraband. Good for follow-on radiological emergency response teams or inspectors.

Examples:

Berkeley Nucleonics Corp <http://www.berkeleynucleonics.com/radiation/rindex.htm>

Bicron/Thermo Electron: <http://www.thermomp.co.uk/us/rmp/>

Exploranium Radiation Detection Systems: <http://www.exploranium.com/gr135pg1.htm>

Perkin Elmer (Ortec): <http://www.ortec-online.com/safeguards.htm>

Quantrads Sensor: <http://www.quantradsensor.com/>

Radiation Alert: <http://www.seintl.com/ursa.htm>

XRF Corporation: <http://www.xrfcorp.com/products/ics.html>

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Tools: Simplified Contamination Survey Instruments

Pros

- “Open window” GM for alpha and beta contamination.
- Most have Good Sensitivity.
- Digital models can have set alarm levels
- Small Size
- Simple operation
- Rugged, simple technology.

Cons

- Sensitive enough alarm in the presence of legitimate commercial, medical, or naturally occurring sources of radiation.
- Many models can not be used in high dose rates which would be of concern to emergency responders performing rescue operations (>0.1 Sv/hr | >10 R/hr).
- Low accuracy (i.e., uses pancake GM for dose measurement)



Tools: Simplified Contamination Survey Instruments

Description:

These simplified meters use thin window (GM) detectors to measure alpha & beta surface contamination as well as dose rates. Although often *more sensitive than the electronic dosimeter*, these devices are not as sensitive as the radiation proximity alert systems. Although they have a *higher range than the personal radiation proximity alert systems*, many models will still not function well in the emergency response dose rate ranges (0.1 Sv/hr or 0.1 Sv). Their simplified operation is designed for the occasional user.

Application:

Well suited for emergency responders and hospital staff who may need to quickly determine if radioactive contamination is present. The units can also alert the wearer when unusual radiation levels are present. Training must be provided on their use as successful contamination monitoring requires specific techniques.

Examples:

Canberra Industries: [http://ww2.canberra.com/PCatalog.nsf/all/RPI_PDF/\\$file/radiagem4.pdf](http://ww2.canberra.com/PCatalog.nsf/all/RPI_PDF/$file/radiagem4.pdf)
 T_A TECHNICAL ASSOCIATES <http://www.tech-associates.com/dept/sales/product-info/tbm-3.html>
 Berkeley Nucleonics Corp: <http://www.berkeley-nucleonics.com/PalmRAD/>
 Health Physics Instruments: http://www.fwt.com/hpi/hpi_4020ds.htm
 Radiation Alert Instruments: <http://www.seintl.com/mon5.htm>,
<http://www.seintl.com/dig50.htm>, <http://www.seintl.com/inspect.htm>,
http://www.seintl.com/insp_exp.htm

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First Responder Training Objectives

- Keep the messages simple! Focus on what you want them to remember a year later.
- At the awareness level (the vast majority) this should be;
 - That medical emergencies take precedent over radiological monitoring,
 - Used correctly, your instruments and protocols ensure responder safety, and
 - The difference between contamination and radiation.
- The overall objective: Increase the responder's comfort level so they can respond effectively.

Effective Training Methods

- “Hands On” training with the tools used by the responders.
 - **Demonstrate** the principles of radiation (types of radiation, distance & shielding effects, etc..)
 - **Utilize the responders own equipment** with actual radiation sources.
- Trainers need to be able to address the radiological concerns of the students.
- Leave training materials that are interesting and can be used as a reference



Important Considerations When Selecting Radiological/Nuclear Training

- Excellent radiological training programs exist both in the government and private sector.
- Many of these programs are offered locally at little or no cost.
- A knowledgeable instructor is key to effective radiological training.
- Don't only focus on "WMD training." Standard radiological emergency response training principles still apply.

Training Sources

- Free Radiological Instrumentation and Training is available through the [Homeland Defense Equipment Reuse \(HDER\)](#) effort
- DOE's [Transportation Emergency Preparedness Program \(TEPP\)](#) offers free, quality, nationwide training for first responders.
- Distance Learning, such as Web Based Training (WBT) on radiation basics is available from the [Department of Energy](#) and Universities.
- Free [Independence Study](#) courses are also available from FEMA
- Free Computer Based Training (CBT) is available from the [Department of Energy](#) and [FEMA](#).
- There are several [Compendiums of WMD Training](#) offered by the Federal Government ([Office of Domestic Preparedness](#) & [FEMA](#))
- The [New Mexico WMD Preparedness Organization](#) has put together an excellent State by State listing of WMD training courses.

Computer Based Training (CBT)

TREATMENT PROCEDURES



DECONTAMINATION PROCESS

Decontamination Deltas

- *The Large Number of Victims* is the first major difference between standard HAZMAT and WMD incidents. Responders may be required to control, triage, decontaminate, and track hundreds, if not thousands, of people at the site.
- *Scene Control* may involve a larger area, a mass casualty situation with numerous responders who all want to "help," and a huge press corps seeking information about the



PREVIOUS

CONTINUE

MENU

EXIT

Radiological Emergency Assistance Resources for First Responders

- Local Fire and Hazmat Responders
- County/State Department of Health Services
- National Guard Civil Support Teams
- Federal assistance also available:
 - DOE's Radiological Assistance Program (RAP) Teams
 - FBI WMD/HAZMAT teams
 - Other National Assistance (Department of Homeland Security - FEMA)
 - Training and equipment resources available through the Department of Justice, Office for Domestic Preparedness Homeland Defense Equipment Reuse (HDER) Program.
{ Calibration and Training Support Provided by Health Physics Society www.hps.org }



National Guard Civil Support Teams



*95th Weapons of Mass Destruction
Civil Support Team
Hayward, California*



Assess

Damage to Infrastructure
Damage to Populace
ID Chemical Hazard
ID Biological Hazard
ID Radiological Hazard

Advise

Vulnerabilities
Anti-terrorism Actions
Response & Recovery
Emergency Preparation
Safeguard the Populace
Follow-on Support

Facilitate

Situational Understanding
Preparatory Activities
RFA Development
Communication Support
Analytical Support
Follow-on Support



Department of Energy's Radiological Assistance Program (RAP)

- Regional, On-Call Responders
- Specialized Equipment
- Volunteers with Extensive Radiological Experience
- Outreach to help 1st Responder Preparation
- Tailored Response that provides access to **all of DOE assets.**

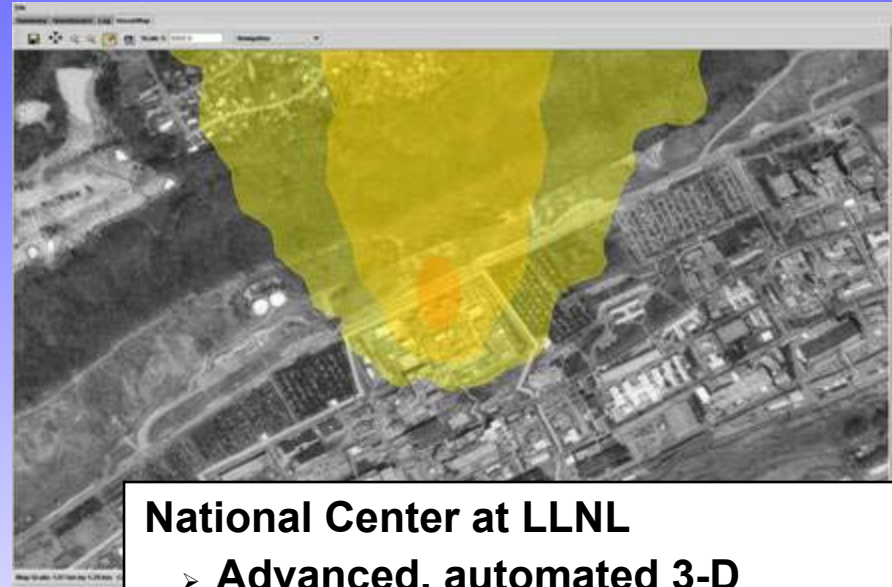
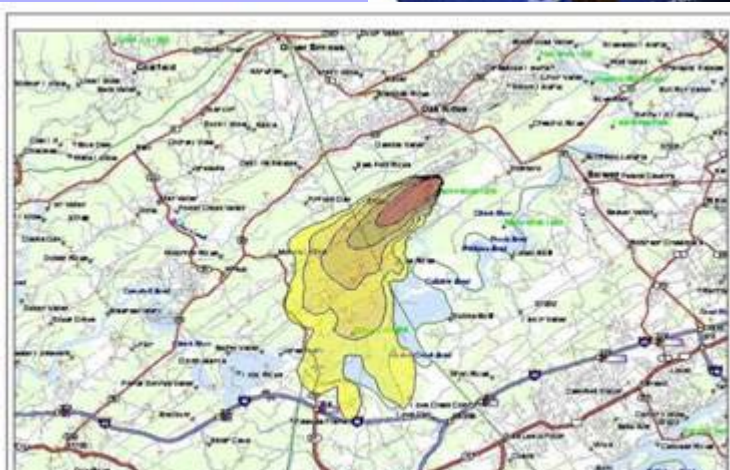


National Atmospheric Release Advisory Center (NARAC)

Real-time advisories for hazardous atmospheric releases

World-wide data coverage

- Real-time weather data
- Terrain & land surface
- Maps



National Center at LLNL

- Advanced, automated 3-D modeling system
- Scientific and technical staff provides training and assistance 24 hrs x 7 days

Real-time Hazard Advisories

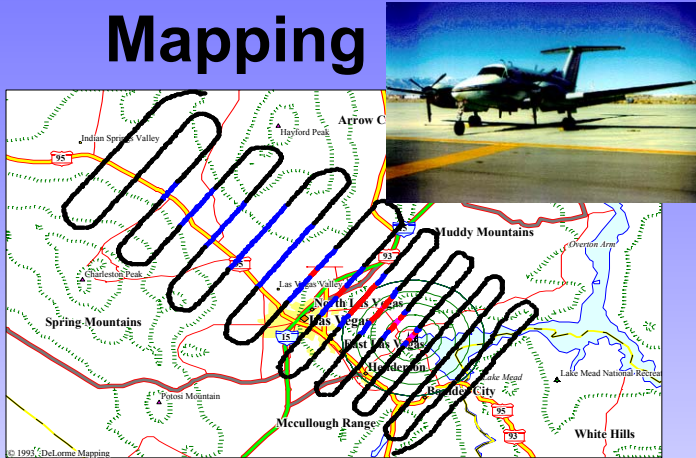
- Nuclear, radiological, chemical, biological & natural releases
- National center predictions available within minutes using Internet/Web tools
- Deployed modeling tools on end user's computer
- Geographical information displays
- Affected population, health risks, recommended actions

Aerial Measurement System

Quick-Look

Radiological

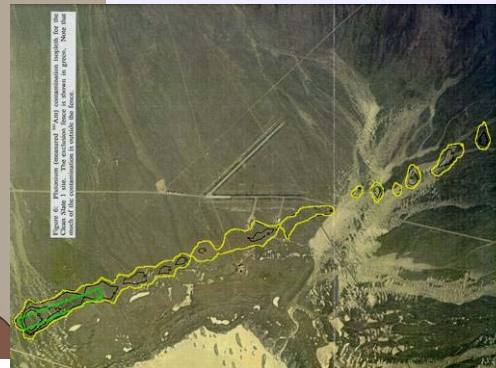
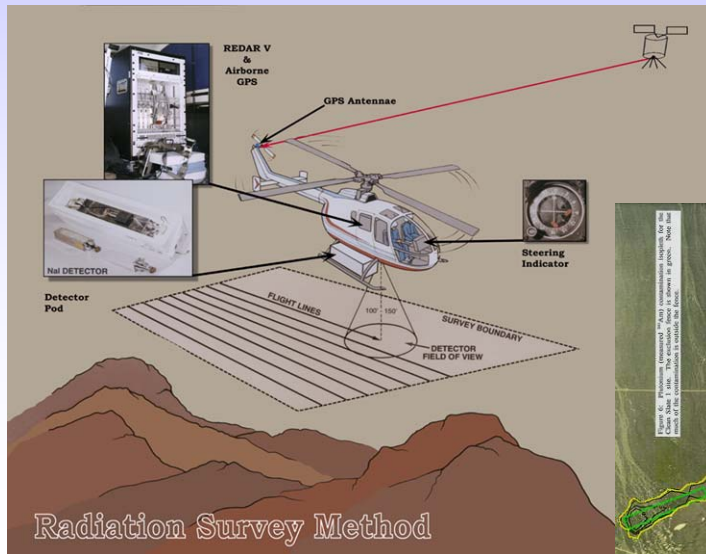
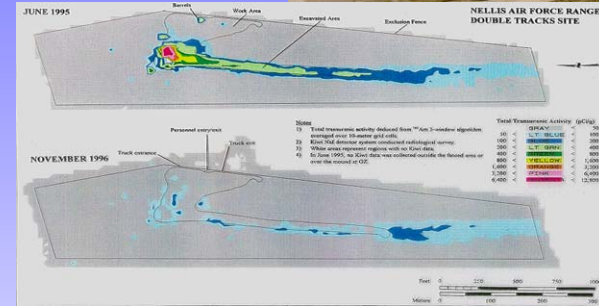
Mapping



Detailed

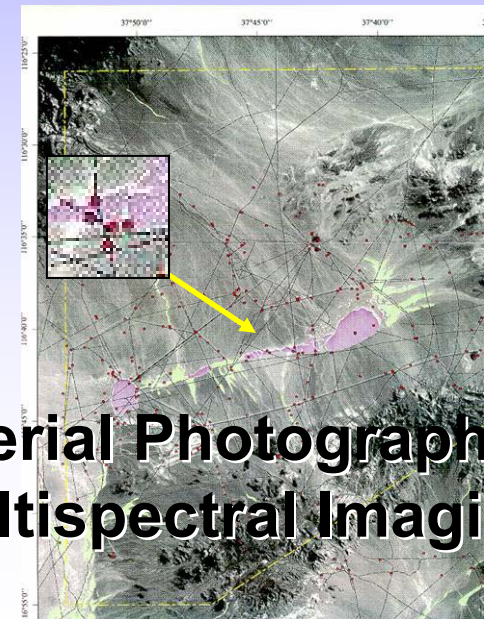
Radiological

Mapping



Aerial Photography

Multispectral Imaging





Accident Response Group (ARG)

- Collaborative effort between the **Department of Energy** and the **Department of Defense** to ensure the safety of America's Nuclear Weapon Stockpile.
- In the event of an accident involving a nuclear weapon, these agencies work together to ensure the **safety** and **security** of weapon recovery, transportation, and disposition operations.



Liquid abrasive cutter. Cutting a spar from a cruise missile



Fiberscope system used to examine internal condition of a warhead electrical system

Federal Radiological Monitoring and Assessment Center (FRMAC) Consequence Management



- FRMAC provides the infrastructure for interagency cooperation
- Measurement database and Graphical Information System helps incorporate and display information quickly.
- Specialists provide expert radiological health assessments.
- Additional capabilities for Extended hotline and personnel monitoring support.
- Mobile radiological laboratories quickly evaluate samples.



REAC/TS MISSION STATEMENT



- The Radiation Emergency Assistance Center/Training Site (REAC/TS) provides:
 - medical advice
 - specialized training
 - on-site assistance for the treatment of all types of radiation exposure accidents.
- 24-hour response center to provide direct support, including deployable equipment and personnel trained and experienced in the treatment of radiation exposure.
- REAC/TS also manages the national use of drugs used to treat internally deposited radioactive material.
 - *In continuous operation since June 1976*



Department of Energy's Radiological Response Assets

ARAC

Atmospheric Release Advisory Capability
Computer Modeling of Transport Diffusion and
Disposition of Radioactive and Hazardous Material

RAP

Radiological
Assistance Program

Radiological measurements
and advice to public sector

FRMAC

Federal Radiological
Monitoring Assessment
Center

Operational and logistical
management cell focused on
radiological consequence
management

Consequence Management

ARG

Accident Response Group
Safely recover nuclear weapons

AMS

Aerial Measurement
System

Airborne radiological sensing
and surveying capabilities

REAC/TS

Radiation Emergency
Assistance
Center/Training Site

Expert medical assistance for
radiation exposure accidents

Summary:

- **Detection tools.** There are many different detection tools for first responders, always consider;
 - The Task
 - The User
- **Training** must be provided to give the responder the confidence to respond properly. Even simple detection tools can lead to inappropriate responses without training.
- **Forge links with radiological responders.** Many local response agencies may not be aware of the radiological resources available to them. The Health Physics Society (www.hps.org/hsc) or American Nuclear Society (www.ans.org) may be able to help with this.

Questions



Other Presentations Available From Brooke Buddemeier

- **Understanding Radiation and Its Effects**
- **Radioactive Material Production, Transportation, Use, and Possible Misuse**
- **Misuse of Radioactive Material: First Responder Considerations**
- **Radiological Emergency Response Assistance and Resources (California)**

For further information, please download the above presentations from the Lawrence Livermore National Laboratory Seaborg Institute training page.

<http://www.cms.llnl.gov/seaborginstitute/training.html>

References

The devices pictured and web pages referenced in this presentation were chosen as examples and in no way represent an endorsement of any manufacturer or product.

Homeland Defense Office of the U.S. Army Soldier and Biological Chemical Command, "Compendium of Weapons of Mass Destruction Training produced by the federal government" [online]. Available at http://hld.sbccom.army.mil:80/downloads/dp/compendium_wmd_aug_2000.pdf

The Department of Energy, Transportation Emergency Preparedness Program (TEPP) [information available online] <http://www.em.doe.gov/otem/program.html>

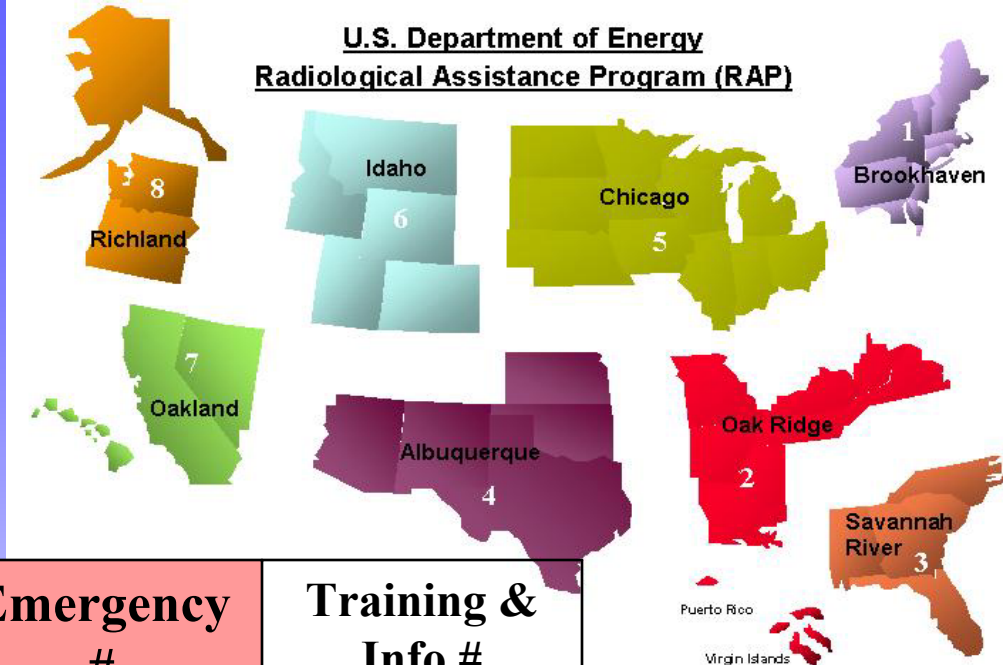
A Practical Guide To Incident Response, ARSCE 2002; WPM-A.4 James G. Barnes, CHP Rocketdyne/Boeing

The Department of Energy's "Partners in Emergency Response" Publication. [information available online] <http://www.doeal.gov/opa/Freedom.htm>

The Department of Energy, Emergency Operations Training Academy (EOTA), Computer Based Training (CBT) for the response to Weapons of Mass Destruction CDs can be copied and have been distributed to each state's FEMA representative who can be found at www.fema.gov/fema/statedr.shtm or by contacting DOE's Emergency Operation Training Academy at www.eota.doe.gov or call (505) 845-5170 ext.172

DOE Emergency Assistance or Training Info, Contact:

U.S. Department of Energy Radiological Assistance Program (RAP)



Region	NNSA Regional Response Coordinator	Emergency #	Training & Info #
1	Steve Centore	(631) 344-2200	(631) 344-7309
2	Steve M. Johnson	(865) 576-1005	(865) 576-9740
3	Christina T. Edwards	(803) 725-3333	(803) 952-6613
4	James E. Straka	(505) 845-4667	(505) 845-5581
5	Christine Van Horn	(630) 252-5731	(630) 252-2498
6	Steven A. Morreale	(208) 526-1515	(208) 526-0199
7	Mike Cornell	(925) 422-8951	(925) 422-0138
8	Kathy Beecher	(509) 373-3800	(509) 376-8519
HQ	Duty Officer, Washington, DC	(202) 586-8100	(202) 586-3201